REMOTE CONTROL SYSTEM USING A CELLULAR TELEPHONE AND ASSOCIATED METHODS

Related Applications

This application is based upon prior filed copending provisional application No. 60/226,854 filed August 22, 2000, and provisional application No. 60/247,131 filed November 10, 2000, the entire disclosures of which are incorporated herein by reference.

Field of the Invention

The present invention relates to control systems, and more particularly, to a remote control system, such as for a vehicle, and which uses a cellular telephone as a remote transmitter for transmitting control signals.

Background of the Invention

Many vehicles include a security system, remote keyless entry system, and/or remote start system which permit a user to perform a function when away from the vehicle. For example, the security system may be switched between armed and disarmed modes by operation of a small handheld remote transmitter. Similarly, remote keyless entry and remote engine starting features can be similarly performed using a

suitable remote transmitter. Typically such transmitters are dedicated and sold as part of the overall remote control system. Such systems can be factory installed or added as aftermarket accessories.

A number of patents relate to using a cellular telephone as a remote transmitter for operating a vehicle control system, such as for example, U.S. Patent No. 5,612,878 to Joao et al. In other words, in such a system, the cellular telephone can be used as the remote transmitter to control a function at the vehicle.

Similarly, U.S. Patent No. 5,815,557 to Larson also discloses a cellular telephone which transmits to a lock and wherein the user operates the buttons of the telephone as he would buttons on a key card to gain access to the secured area. U.S. Patent No. 5,276,728 to Pagliaroli et al. discloses a vehicle security system including a short range portable transmitter that may be used to transmit a command code to the receiver which may be in the same frequency ranges as the cellular telephone transmitters. U.S. Patent Nos. 5,370,201 to Inubshi, 5,535,844 to Samford, and 5,917,405 to Joao also disclose a cellular telephone communicating with a receiver at the vehicle.

Unfortunately, none of the above identified prior art patents address how a cellular telephone or its associated vehicle receiver can be configured to operate together easily and while providing security from unauthorized operation by other cellular telephones. In addition, these cellular telephones typically require the use of intervening cellular communications infrastructure, i.e., relay towers or base stations, when used as a remote transmitter. The

use of relay towers or base stations by a cellular telephone often results in an expense to the user.

Summary of the Invention

In view of the foregoing background, it is therefore an object of the invention to provide a remote control system and related methods with an enhanced security of operation.

Another object of the invention is to avoid being charged by the cellular network provider when using a cellular telephone as a remote transmitter.

These and other objects, features and advantages in accordance with the present invention are provided by a vehicle remote control system to be operated directly via a cellular telephone without using intervening cellular communications infrastructure. The cellular telephone comprises an input device, such as a keypad for example, and a transmitter for transmitting signals relating to a command code entered from the input device and a unique identification code for the cellular telephone.

The vehicle remote control system comprises a receiver positioned at the vehicle for receiving signals directly from the cellular telephone without using intervening cellular communications infrastructure, and a controller also positioned at the vehicle that is switchable between a learning mode and an operating mode.

When the controller is in the learning mode, the controller learns the unique identification code of a cellular telephone so that the cellular telephone is an authorized cellular telephone. When the controller is in the operating mode, the controller controls at

least one vehicle function responsive to signals received from the authorized cellular telephone. The controller may be switchable to the learning mode responsive to a user operable switch connected thereto, or a user operable in combination with at least one vehicle device.

A cellular telephone is advantageously used to transmit signals to the remote control system so that the transmission range may be further than provided by typical handheld remote transmitters. The user does need not to carry both a cellular telephone and a handheld remote transmitter since the cellular telephone is used for both conventional calls and remote vehicle operations.

In addition, since the cellular telephone transmits signals to the remote control system without using intervening cellular communications infrastructure, i.e., without using relay towers or base stations, the user will avoid being charged for transmitting such signals. This is possible when the controller is selectively responsive to command codes from the cellular telephone having less than seven digits. That is, the command code is less than a typical seven digit telephone number so that a cellular telephone relay tower or base station does not recognize the command code as such, and consequently, will not process the call. Even though the cellular telephone transmits signals directly to the remote control system without using intervening cellular communications infrastructure, the cellular telephone communicates with the intervening cellular communications infrastructure (i.e., one or more relay stations and/or a base station) so that the cellular

telephone is operational. Once the cellular telephone is operational, then the command code and the unique identification signal may be directly transmitted to the remote control system.

The controller may cooperate with the receiver to learn the unique identification code of the cellular telephone by wireless reception from the cellular telephone. To prevent the controller from learning a unique identification code from adjacent cellular telephones when in the learning mode, the receiver has a controllable sensitivity. When the receiver has a reduced sensitivity, the cellular telephone must be placed closely adjacent the receiver when in the learning mode.

Another embodiment of the present invention is to interface the cellular telephone via a cable to an electrical connector on the controller to learn the unique identification code. In other words, an RF transmission from the cellular telephone may be avoided when the controller learns the unique identification code of the cellular telephone.

Various embodiments of the controller are provided for the vehicle remote control system. In one embodiment the controller comprises a security controller switchable between armed and disarmed modes responsive to signals from an authorized cellular telephone. In another embodiment, the controller comprises a door lock controller for locking or unlocking at least one vehicle door responsive to signals from an authorized cellular telephone. In yet another embodiment, the controller comprises an engine start controller for starting a vehicle engine

responsive to signals from an authorized cellular telephone.

Another aspect of the invention is a method for vehicle remote control directly via a cellular telephone without using intervening cellular communications infrastructure. As discussed above, the cellular telephone includes an input device and a transmitter for transmitting signals relating to a command code entered from the input device and a unique identification code for the cellular telephone.

The method preferably includes receiving signals directly from the cellular telephone at the vehicle without using intervening cellular communications infrastructure, and switching the controller positioned at the vehicle to a learning mode and learning the unique identification code of a cellular telephone so that the cellular telephone is an authorized cellular telephone. The method preferably further includes switching the controller to an operating mode and controlling at least one vehicle function responsive to signals received from the authorized cellular telephone.

Another aspect of a remote control system according to the invention is directed to a door opening system. The door opening system, such as a garage door, is to be operated directly via a cellular telephone without using intervening cellular communications infrastructure.

Yet another aspect of the remote control system is directed to a building security system to be operated directly via a cellular telephone without using intervening cellular communications infrastructure. The building controller may be

switchable between an armed mode for generating an alarm responsive to a building sensor, and a disarmed mode. In addition, the building controller may also be connected to at least at least one door lock for unlocking the door lock responsive to the signals received from the authorized cellular telephone.

Brief Description of the Drawings

FIG. 1 is a schematic diagram of a vehicle remote control system in accordance with the present invention.

FIG. 2 is a schematic diagram of a vehicle remote control system including a security controller in accordance with the present invention.

FIG. 3 is a schematic diagram of a vehicle remote control system including a door lock controller in accordance with the present invention.

FIG. 4 is a schematic diagram of a vehicle remote control system including an engine start controller in accordance with the present invention.

FIG. 5 is a flowchart illustrating a method for vehicle remote control directly via a cellular telephone in accordance with the present invention.

FIG. 6 is a schematic diagram of a remote control system for opening a garage door in accordance with the present invention.

FIG. 7 is a schematic diagram of a remote control system for granting access to a building in accordance with the present invention.

Detailed Description of the Preferred Embodiments

The present invention will now be described more fully hereinafter with reference to the

accompanying drawings in which preferred embodiments of the invention are shown. This invention may, however, be embodied in many different forms and should not be construed as limited to the illustrated embodiments set forth herein. Rather, these embodiments are provided so that this disclosure will be thorough and complete, and will fully convey the scope of the invention to those skilled in the art. Like numbers refer to like elements throughout. Prime and multiple prime notation are used in alternate embodiments to indicate similar elements.

A vehicle remote control system **10** in accordance with the present invention will be described with reference to FIGS. 1-5. The vehicle remote control system **10** is operated directly via a cellular telephone **12** without using intervening cellular communications infrastructure, i.e., without using relay towers or base stations. However, those of skill in the art will readily appreciate that the cellular telephone **12** is in communications with the intervening cellular communications infrastructure so that the cellular telephone is active (i.e., operational). Once the cellular telephone **12** is active, communication with the vehicle remote control system **10** is performed without using the intervening cellular communications infrastructure. The cellular telephone **12** includes an input device, such as a keypad **14** for example, and a transmitter included therein for transmitting signals relating to a command code entered from the keypad, and a unique identification code for the cellular telephone.

The remote control system **10** includes a receiver **15** positioned at the vehicle **16** with an antenna **34** connected thereto for receiving signals

directly from the cellular telephone **12** without using intervening cellular communications infrastructure. A controller **18** is also positioned at the vehicle **16** and is switchable between a learning mode and an operating mode. When the controller **18** is in the learning mode, the controller learns the unique identification code of the cellular telephone **12** so that the cellular telephone is an authorized cellular telephone.

When the controller **18** is in the operating mode, the controller controls at least one vehicle function responsive to signals received from the authorized cellular telephone **12**. The at least one vehicle function is supported by the vehicle device **32** connected to the controller **18**. The at least one vehicle function may include switching between armed and disarmed modes, remotely locking and unlocking the vehicle doors, or remote engine starting.

As will be discussed in greater detail below, the vehicle remote control system **10** includes various embodiments. In one embodiment, the controller **18** is a security controller **18'** that switches between armed and disarmed modes responsive to signals form the cellular telephone **12**. In another embodiment, the controller **18** is a door lock controller **18"** for locking or unlocking at least one vehicle door **28** responsive to signals form the cellular telephone **12**. In a third embodiment, the controller **18** is an engine start controller **18"'** for starting a vehicle engine responsive to signals form the cellular telephone **12**.

A cellular telephone **12** is advantageously used to transmit signals to the remote control system **10** so that the transmission range may be further than

provided by typical handheld remote transmitters. The user does need not to carry both a cellular telephone **12** and a handheld remote transmitter since the cellular telephone is used for both conventional calls and remote vehicle operations.

In addition, since the cellular telephone **12** transmits signals to the remote control system **10** without using intervening cellular communications infrastructure, i.e., without using relay towers or base stations, the user will avoid being charged for transmitting such signals. Even though the cellular telephone **12** must register with the intervening cellular communications infrastructure, this is possible when the controller **18** is selectively responsive to command codes from the cellular telephone **12** having less than seven digits. That is, the command code is less than a typical seven digit telephone number so that a cellular telephone relay tower or base station does not recognize the command code as a telephone number. The learning mode of the controller **18** for learning the unique codes of the cellular telephone **12** will be discussed in greater detail below.

In the illustrated embodiment of FIG. 2, a security controller **18'** is connected to a number of security sensors **20a'-20n'**, which may include door, trunk, and/or hood pin switches, as well as shock, proximity, or other types of sensors as will be understood by those skilled in the art. The security controller **18'** monitors the sensors **20a'-20n'** and if the security controller is in an armed mode, for example, a sensor **20a'-20n'** may trigger an alarm indicator at the vehicle **16**. If the security controller **18'** is in the disarmed mode, an alarm

indicator is not generated, and normal operation of the vehicle **16** is typically permitted.

The security controller **18'** may be switched between armed and disarmed modes to permit operation by the user (disarmed mode), and to protect the vehicle **16** when the user is away from the vehicle (armed mode). An authorized cellular telephone **12** is used to switch the security controller **18'** between the armed and disarmed modes. The security controller **18'** may also include a passive arming feature which automatically arms the controller based upon the user exiting the vehicle **16**.

The security controller **18'** may also be connected to an engine disable circuit or device **24'** which can prevent or disable starting and/or running of the vehicle engine. This would typically be used when an alarm was triggered by one or more of the security sensors **20a'-20n'**.

An audible indicator **22'**, such as the vehicle horn or a siren, is also illustratively connected to the security controller **18'**. The audible indicator **22'** is used to sound an alarm condition, for example, but is also used to provide an audible indication that the security controller **18'** has been commanded or has already changed modes. The audible confirmation indication is usually of short duration and/or amplitude and is typically known as a confirmation chirp.

Vehicle lights **26'** are also illustratively connected to the security controller **18'**. The lights **26'** may be flashed during an alarm indication. In addition, the lights **26'** may also be flashed along with

the confirmation chirp when the security controller **18'** is switched between armed and disarmed modes. For example, one audible chirp and light flash may be given to confirm that the security controller **18'** has been switched to the armed mode. Two flashes and chirps may be used to indicate that the security controller **18'** has been disarmed. Other combinations are also possible as will be appreciated by those skilled in the art.

In the illustrated embodiment, power door locks **28'** may also be connected to the security controller **18'**. For example, the security controller **18'** could cause the power door locks **28'** to move to the unlocked position when the user returns to the vehicle **16** and switches the controller to the disarmed mode. Conversely, the security controller **18'** could move the door locks **30'** to the locked position upon the user switching the controller to the armed mode.

Placing the security controller **18'** in the learning mode will now be discussed. The vehicle remote control system **10'** further includes a user operable switch **30'** connected to the security controller **18'**. The user operable switch **30'** is preferably hidden from view within the vehicle **16**, e.g., under the dash, yet is readily accessible by the user. The security controller **18'** is switchable to the learning mode responsive to the user operable switch **30'**. A designated switch, such as a valet switch, for example, can be used to cause the security controller **18'** to switch to the learning mode.

In another embodiment, the security controller **18'** is switchable to the learning mode

responsive to the user operable switch **30'** and responsive to at least one vehicle device **32'**. The at least one vehicle device **32'** may include trunk, door and hood switches, and even the ignition switch, for example. The function of these vehicle devices **32'** may overlap a portion of the illustrated sensors **20a'-20n'**. The designated switch **30'** in combination with a vehicle device **32'** can be used to cause the security controller **18'** to switch to the learning mode.

The receiver **15'** has a controllable sensitivity so that when the security controller **18'** is in the learning mode, the controller reduces the sensitivity of the receiver. Consequently, the cellular telephone **12** must be placed closely adjacent the antenna **34'** of the receiver **15'** so that when the user presses 'SEND' on the keypad **15'** of the cellular telephone, the security controller **18'** learns the unique identification code of the cellular telephone.

By reducing the sensitivity of the receiver **15'**, this avoids the security controller **18'** from learning a unique identification code from adjacent cellular telephones. Once this has been performed, the cellular telephone **12** becomes an authorized cellular telephone so that when the security controller **18'** is in the operating mode, it is switchable between armed and disarmed modes.

As readily understood by one skilled in the art, a typical cellular telephone **12** sends coded identifying information along with the speech information. The coded identifying information includes, for U.S. cellular telephones, for example, an electronic serial number (ESN) and a mobile

identification number (MIN), with each transmission. The ESN corresponds to the unique identification code of the cellular telephone **12**, for example. The ESN may be fixed but not unique, while the MIN is typically unique. The MIN is typically the phone number for the cellular telephone **12**, for example.

However, as noted above, the security controller **18'** may be selectively responsive to command codes having less than seven digits from the cellular telephone **12**. This is done so that when the cellular telephone **12** transmits signals to the remote control system **10'**, it is done without using intervening cellular communications infrastructure.

When the security controller **18'** is in the operating mode, the controller controls at least one vehicle function by switching between armed and disarmed modes responsive to signals received from the authorized cellular telephone **12**. In other words, the security controller **18'** is responsive to a particular command code transmitted by the cellular telephone **12**. For example, pressing "1" and then "SEND" may switch the security controller **18'** to an armed mode, whereas pressing "2" and then "SEND" may switch the security controller to a disarm mode. The security controller **18'** compares the unique identification code transmitted by the cellular telephone **12** to a learned unique identification code. The learned unique identification code may be stored in a memory internal to the security controller **18'** or in an external memory, such as memory **36'**.

In addition, for certain cellular telephone systems, the frequency on which the cellular telephone

12 transmits may change from time-to-time, such as to avoid adjacent or co-channel interference. Accordingly, the receiver **15'** may include a frequency scanning feature to scan the available frequencies to find the cellular telephone of interest as will also be appreciated by those skilled in the art. Of course, some cellular systems may not need such dynamic frequency reallocation, and the scanning portion would then not be needed.

The receiver **15'** and the security controller **18'** in accordance with the invention includes circuitry and/or software to enter the learning mode and learn the unique identification code or codes from the cellular telephone **12**, so that the cellular telephone is then authorized to operate a designated vehicle function. Of course, other unique or coded signals could be transmitted from the cellular telephone **12** and learned by the receiver **15'** and the security controller **18'**. For example, the cellular telephone **12** could include a transmitter portion (not shown) like a conventional remote handheld vehicle security transmitter. The remote transmitter could also be carried in a flip out portion of a cellular telephone housing, for example. The learning mode may be entered by any of a number of methods as will be appreciated by those skilled in the art. In addition, the cellular telephone **12** could be voice activated so that the signals transmitted therefrom could be initiated without using the keypad **14**.

Referring now to FIG. 2, another embodiment of the vehicle remote control system **10"** includes a door lock controller **18"** connected to the door locks **28"**. Operation of the door lock controller **18"** is

similar to the security controller **18'** and will not be discussed in great detail. However, when the door lock controller **18"** is in the operating mode, the controller unlocks or locks the door locks **28"** of the vehicle **16** responsive to signals received from the authorized cellular telephone **12**. For example, pressing "1" and then "SEND" may unlock the doors of the vehicle **16**, whereas pressing "2" and then "SEND" may lock the doors of the vehicle.

Referring now to FIG. 3, another embodiment of the vehicle remote control system **10"'** includes an engine start controller **18"'** connected to the vehicle's engine **38"'**. Operation of the engine start controller **18"'** is similar to the security controller **18'** and will not be discussed in great detail. However, when the engine start controller **18"'** is in the operating mode, the controller starts the engine **38"'** responsive to signals received from the authorized cellular telephone **12**. For example, pressing "1" and then "SEND" may start the engine **38"'**.

An alternate approach to the learning mode for entering the unique identification code from the cellular telephone **12** avoids the free space transmission of these signals. Many cellular telephones include a signal output jack so that a separate antenna and/or antenna and amplifier combination can be connected thereto, such as for connecting and operating a cellular telephone in a vehicle, for example.

In accordance with this aspect of the invention, an electrical connector **50"'** is coupled to the engine start controller **18"'** and cooperates

therewith via a cable **52** to permit the engine start controller to interface with the cellular telephone **12** to learn the codes from the cellular telephone. The engine start controller **18"'** can be temporarily electrically connected to the output jack of the cellular telephone **12** to learn its unique identification code as described above. Alternatively, the cellular telephone **12** may be temporarily directly connected to the electrical connector **50"'** in lieu of using the cable **52**. These variations of the invention, which are also applicable to the respective vehicle remote control systems illustrated in FIGS. 1-3, reduce the possibility of learning a code from an undesired telephone operating in proximity during learning of the desired telephone.

A method aspect for vehicle remote control directly via a cellular telephone **12** without using intervening cellular communications infrastructure will now be discussed with reference to FIG. 5. As discussed above, the cellular telephone **12** includes a keypad **14** and a transmitter for transmitting signals relating to a command code entered from the keypad and a unique identification code for the cellular telephone.

From the start (Block **60**) the method includes receiving signals directly from the cellular telephone **12** at the vehicle **16** without using intervening cellular communications infrastructure (Block **62**), and switching the controller **18** positioned at the vehicle **16** to a learning mode and learning the unique identification code of a cellular telephone **12** so that the cellular telephone is an authorized cellular telephone at Block

64. The method further includes switching the controller **18** to an operating mode and controlling at least one vehicle function responsive to signals received from the authorized cellular telephone **12** at Block **66.** The method ends at Block **68.**

Another illustrative embodiment of a remote control system according to the invention is understood with reference to FIG. 6. The illustrated door opening system **70** includes a conventional overhead door opener **72,** such as for a garage. The door opener **72,** in turn, includes a motor **74** and receiver **75**/door controller **76** as would be readily understood by one skilled in the art. An antenna **77** is connected to the receiver **75.** The illustrated segmented garage door **78** is guided by a pair of opposing tracks, not shown.

More particularly, the door opening system is to be operated directly via a cellular telephone **12** without using intervening cellular communications infrastructure. The cellular telephone **12** includes a keypad **14** and a transmitter for transmitting signals relating to a command code entered from the keypad and a unique identification code for the cellular telephone.

The illustrated receiver **75** is associated at the door for receiving signals directly from the cellular telephone **12** without using intervening cellular communications infrastructure. The door controller **76** is switchable between a learning mode (via switch **80**) and an operating mode. When the door controller **76** is in the learning mode, it learns the unique identification code of a cellular telephone so that the cellular telephone is an authorized cellular

telephone. When the door controller **76** is in the operating mode, it moves the door **78** between open and closed positions responsive to signals received from the authorized cellular telephone **12**.

Yet another illustrative embodiment of a remote control system **89** according to the invention is understood with reference to FIG. 7. The illustrated building security system **90** is to be operated directly via a cellular telephone **12** without using intervening cellular communications infrastructure. The cellular telephone includes a keypad **14** and a transmitter for transmitting signals relating to a command code entered from the keypad and a unique identification code for the cellular telephone.

The building security system **90** comprises a receiver **105** positioned at the building **92** for receiving signals directly from the cellular telephone **12** without using intervening cellular communications infrastructure. An antenna **106** is connected to the receiver **105**. A building controller **94** is connected to the receiver **105** and is switchable between a learning mode (via switch **108**) and an operating mode. When the building controller **94** is in the learning mode, it learns the unique identification code of a cellular telephone so that the cellular telephone is an authorized cellular telephone. When the building controller **94** is in the operating mode, it grants access to the building **92** responsive to signals received from the authorized cellular telephone.

The building controller **94** is also connected to building sensors **112**. The building sensors **112** may be of a conventional switch or proximity sensor type as

will be appreciated by those skilled in the art. The building controller **94** is also connected to alarm indicators **114** and system indicators **116**. The alarm indicators **114** may include a local siren, or may include a telephone dialing circuit to contact a remote monitoring station. The system indicators **116** may include any of a number indicators, such as lights, audible tone generators, etc.

The building controller **94** is switchable between an armed mode for generating an alarm responsive to the building sensors **112**, and a disarmed mode. The building controller **94** is also connected to at least at least one door lock **120**, and wherein the building controller unlocks the door lock responsive to the signals received from the authorized cellular telephone **12**.

Many modifications and other embodiments of the invention will come to the mind of one skilled in the art having the benefit of the teachings presented in the foregoing descriptions and the associated drawings. Therefore, it is to be understood that the invention is not to be limited to the specific embodiments disclosed, and that modifications and embodiments are intended to be included within the scope of the appended claims.